REMARKS

Claims 1-25 are currently active.

Claims 26, 27 and 28 have been canceled.

Antecedent support for the amendments to Claim 1 is found in figure 22.

The rejection under 35 U.S.C. Section 112 has been obviated by the cancellation of Claim 27.

The Examiner has rejected Claims 1-4, 26 and 28 as being anticipated by Antonov. In view of the amendments to the claim, applicants respectfully traverse this rejection.

The Antonov patent describes a fundamentally different approach to the interconnection of nodes (referred to as "ring stations" in the Antonov patent) on multiple rings in comparison with that of the claimed invention. In the Antonov patent, a switching network comprised of a plurality of switch modules (referred to as routing elements) is inserted within a plurality of non-intersecting rings. A path to transmit a data packet from a

sending node to a receiving node on a different ring must always pass through a switching network which will connect the sender's ring to the receiver's ring.

Antonov teaches a set of rings, all of which are non-intersecting. Since they do not intersect, the way the nodes on rings communicate is through switches. Furthermore, for any node on any ring taught by Antonov, there is only one type of path available to it to communicate with any other node on the same ring or in any other ring, said path having to be configured via the switches. In contradistinction, applicants' claimed invention has the inherent topology property that "each of the core rings is intersected by means of a plurality of spanning rings" with said spanning rings being interconnected via spanning links, such that "there are two possible types of paths between nodes comprised of links and nodes", and, "each node has only one of the two possible types of paths to other nodes available to it". Antonov does not teach or suggest this topology enhancement, and in fact teaches away from applicants' claimed invention, because Antonov only makes available one type of path that must be configured via switches to every node of every ring, resulting in the disadvantage of said path having the possibility of being blocked because of the existing configuration state of the switches.

The distinction between the fault tolerant butterfly switch topology and the claimed invention is evident from the teachings of the Antonov patent which states that "the invention is a data packet routing device comprising a plurality of ring pairs including a series

of first ring stations and a series of mid-switch routing elements followed by an end-switch routing element, and second ring including a series of first ring stations and a series of mid-switch routing elements followed by an end-switch routing element, where each mid-switch and end-switch being adapted to switch data packets between the first and second ring stations, data packet outputs of the series of the first and second ring stations being provided to inputs of the series mid-switch routing elements and data packet outputs of the end-switch routing elements being provided to inputs of the series of the first and second ring stations; and vertical links that provide data path passage between different ones of the ring pairs, the mid-switch routing elements being further adapted to switch data packets between different ones of the ring pairs via the vertical links."

The key distinction of the device described in the Antonov patent in comparison with the claimed invention is the explicit use of embedded switching networks to interconnect the nodes on the rings in the butterfly switch topology. In clear contrast, the claimed invention is comprised of a specified hierarchy of intersecting rings. The hyper-ring nodes of the claimed invention operate both as routers and processors. All embodiments in the Antonov patent similarly use and/or are based on the existence of an embedded switching network, rendering them irrelevant regarding any comparison with the claimed invention.

Regardless of the type of switching network actually utilized in the device described in the Antonov patent, the use of a switching network inserted within a plurality of

non-intersecting rings provides a limited type of connectivity between nodes on the rings. Indeed, the motivation for the connectivity provided by the so-called butterfly switch in the Antonov patent is primarily related to bypassing other nodes in the topology so as to achieve some degree of fault tolerance. Regardless of the intended use of the embedded switching network, the connectivity that is provided between nodes on the stack of non-intersecting rings is quite restricted. Moreover, any involvement of a switching network in providing communications between nodes (or ring stations) has significant ramifications regarding increased network cost, increased delays in transmission caused by switching network blocking and multiple cycles of data packets passages through the network, data loss due to buffer overflow, complexity of network control, and the introduction of a variety of single points of network failure.

Between a node on one ring and a node on another ring, and even relative to some paths between nodes in the same ring, there will always be the routing complexity and delay of passing data through the switching network in the multiple ring network described in the Antonov patent. There is no discussion in the Antonov patent of the use of embedded paths available between sending and receiving nodes provided by intersecting the rings within the ring stack.

The path between a sending node and receiving node on different rings as described in the Antonov patent must also in general pass through any intermediate nodes on

the sender's ring between the sending node and the entry port to the switching network and likewise pass through any intermediate nodes between the exit port from the switching network and the receiving node, as well as the intermediate routing modules. Together with the delay associated with transmission through the stages of the switching network, the resulting overall delay that results can be significant.

As the number of rings in the network described in the Antonov patent grows, the number of stages of routing elements similarly grows. In general, switching networks with N inputs/outputs of the type represented by the butterfly switch will have $O(\log_2 N)$ stages of routing elements. For applications involving large numbers of rings, the multi-stage switching network control associated with routing through the switching network can be complex, requiring that the state of the connectivity currently being provided by routing elements in the switching network be stored and examined in a database.

The butterfly switch described in the Antonov patent can block needed connection paths between nodes. Possibly, the butterfly switch could be replaced by a non-blocking switching network. But non-blocking switching networks are usually prohibitively expensive in terms of switching hardware demands. Accordingly, if a switching network for which blocking is a possibility is inserted in the stack of non-intersecting rings, it is in general possible that the current state of connectivity within the switching network could be such that a needed connection path cannot be established and the desired sender to receiver connectivity

on the involved rings cannot be provided unless the existing connection paths implemented within the switching network are rearranged. Such rearrangement can be extensive, requiring that multiple existing connection paths be modified, and that during the modifications, transmission of information cease until the new connection paths have been set-up.

Self-routing of packets, between nodes in the claimed invention can be accomplished by means of processing header information containing sender and receiver hyper-ring addresses in coordination with the routing trees. There is no need to store the current connection state of the entire hyper-ring network at a central controller node so as to determine available paths for a new requested connection path. In fact, there are network algorithms that are available for use with the claimed invention that require only state information relative to nearest neighboring node connectivity on the hyper-ring.

Similarly, the routing of packets on the claimed invention utilizing bidirectional links can be based on the availability of public domain software for Internet types of protocols such as TCP and IP, which offer mechanisms for reliability, congestion control, and packet flow control.

The switching network utilized and the switching network controller in the network as described in the Antonov patent represent single points of failure that could prevent the operation of the network. In contrast, a failed node in the hyper-ring can be avoided by

other nodes by means of the utilization of spanning rings or links connected to a predecessor node.

Overall, in comparison with approach described in the Antonov patent, providing robust connectivity between nodes in the claimed invention is not dependent on the performance of a separate complex operational component such as a switching network. Instead, the inherent connectivity resulting from a hierarchy of intersecting rings within the hyper-ring together with the operation of the nodes as both processors and routers represent salient and distinguishing factors that clearly differentiate the two infrastructures for transmission of information between sets of nodes in a networking environment.

None of the patents cited by the Examiner describe a definitive specification of a topology of a 2^r node hyper-ring for $r \geq 4$ based on a hierarchy r-1 sets of intersecting rings, where each such ring is comprised of 2^i nodes and links, for $I \leq r - 1$ with which combinations of the intersecting rings can be employed to concurrently implement interconnected node and link disjoint configurations.

The Ulug patent "Transparent Intelligent Network for Data and Voice" describes an abstract communication framework with dynamic bandwidth expansion for maximizing the use available bandwidth. A centralized node is used to connect to peripheral "star nodes." The centralized nodes represent single points of failure in the network. There is

no anticipation in any of the claims regarding a specification of a hyper-ring network topology based on the intersection of rings.

The Moiin et al. patent "Determining Cluster Membership in a Distributed Computer System" describes a membership determination algorithm. There is no anticipation in any of the claims regarding a specification of a hyper-ring network topology based on the intersection of rings.

Accordingly, Claims 1-4 are not anticipated by Antonov.

The Examiner has rejected Claims 5, 6, 9-13 and 17-24 as being unpatentable over Antonov in view of Eslambolchi. Applicants respectfully traverse this rejection.

Eslambolchi does not teach "there are two types of paths comprised of links and nodes from each node on any core ring to any other node on any other core ring, and each node has only one of the two types of paths available to it". Accordingly, the combination of Antonov and Eslambolchi does not teach "there are two types of paths comprised of links and nodes from each node on any core ring to any other node on any other core ring, and each node has only one of the two types of paths available to it". Thus, Claim 1 is not obvious from the applied art of record. Claims 5, 6, 9-13 and 17-24 are dependent to parent Claim 1 and are patentable for the reasons Claim 1 is patentable.

The Examiner has rejected Claims 7 and 8 as being unpatentable over Antonov in view of Eslambolchi and further in view of Ulug. Applicants respectfully traverse this rejection. Ulug does not teach "there are two types of paths comprised of links and nodes from each node on any core ring to any other node on any other core ring, and each node has only one of the two types of paths available to it". Accordingly, the applied art of record does not teach or suggest Claim 1. Claims 7 and 8 are dependent to parent Claim 1 and are patentable for the reasons Claim 1 is patentable.

The Examiner has rejected Claims 14-16 as being unpatentable over Antonov in view of Eslambolchi and further in view of Doshi. Applicants respectfully traverse this rejection. Doshi does not teach "there are two types of paths comprised of links and nodes from each node on any core ring to any other node on any other core ring, and each node has only one of the two types of paths available to it". Accordingly, the applied art of record does not teach Claim 1. Claims 14-16 are dependent to parent Claim 1 and are patentable for the reasons Claim 1 is patentable.

The Examiner has rejected Claim 25 as being unpatentable over Antonov in view of Eslambolchi and further in view of Moiin. Applicants respectfully traverse this rejection. Moiin does not teach "there are two types of paths comprised of links and nodes from each node on any core ring to any other node on any other core ring, and each node has only one of the two types of paths available to it". Accordingly, the applied art of record does

not teach Claim 1. Claim 25 is dependent to parent Claim 1 and is patentable for the reasons Claim 1 is patentable.

In view of the foregoing amendments and remarks, it is respectfully requested that the outstanding rejections and objections to this application be reconsidered and withdrawn, and Claims 1-25, now in this application be allowed.

Respectfully submitted,

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